Searching for signs of bilby (*Macrotis lagotis*) activity in central Western Australia using observers on horseback

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We tested the effectiveness of observers on horseback for searching for signs of activity of bilbies reintroduced to a former pastoral lease in central Western Australia. As a means of transport, horses were able to traverse country not readily accessible to motorised transport including all-terrain vehicles, were productive in terms of area searched per unit time, were an elevated platform from which to observe signs of activity, and had a low impact on soil and vegetation. In this trial, a distance of 27 km was traversed with observers visually inspecting 121.5 ha for signs of bilby activity. Ten fresh (active) bilby burrows were detected, equating to an active burrow every 12.15 ha. Further research will focus on estimating bilby population from the number of active burrows.

KEYWORDS: arid zone, bilby, fauna conservation, *Macrotis lagotis*, translocations.

INTRODUCTION

The greater bilby (*Macrotis lagotis*) is an omnivorous, burrowing marsupial that was distributed throughout ~70% of Australia prior to European settlement. Its population has since significantly declined and its distribution has contracted into the driest and least fertile parts of its former range (Watts 1969; Southgate 1990). Over the period 2007–2010, 128 captive-bred bilbies were reintroduced to Lorna Glen, a former pastoral lease in central Western Australia some 160 km northeast of the town of Wiluna (Pertuisel 2010). The reintroductions were preceded by four years of introduced predator control and other conservation activities associated with Rangelands Restoration, a project jointly managed by the Department of Environment and Conservation (DEC) and the Wiluna Aboriginal Community (Miller *et al.* 2010).

Success of fauna reintroductions is determined by the long-term persistence and breeding of the reintroduced species. It is not feasible to obtain counts of individual bilbies in these landscapes (Southgate *et al.* 2005), but measures of activity can give estimates of relative abundance and microhabitat preferences. In the first few months after release, a group of bilbies was closely monitored by radio tagging and associated cage trapping to obtain information about survivorship of founder animals. Bilbies are no longer being radio-tagged and have dispersed from their points of release. As reported by Southgate *et al.* (1995), bilbies are difficult to monitor by trapping or spotlighting because of their low density, mostly solitary behaviour and great mobility. When bilbies were initially reintroduced at Lorna Glen, localised trapping in areas where they were known to occur was successful, but as the animals dispersed, trapping was not an effective way of assessing bilby populations due to extremely low trap success (Pertuisel 2010). A feasible alternative was to use tracks, diggings, scats and burrows as a surrogate for their occurrence and relative abundance.

Prior to this trial, we searched for signs of bilby activity using all-terrain vehicles (ATVs) on and off tracks, and observers on foot. Neither technique was found to be practical; ATVs were impeded by thick scrub, fallen timber beneath mulga groves, dense spinifex and recently burnt spinifex. They caused unacceptable crushing damage to vegetation and sensitive soil cryptogamic crusts, and were restricted by vehicle maintenance issues (punctures, grass seed blockages, etc) and fuel requirements. When used on formed tracks, very few signs of bilbies were observed. For example, 500 km of swept tracks surveyed over five nights on two occasions revealed only one set of bilby tracks. A small number of diggings, tracks and burrows were found by people walking through the bush, but the sample size was limited by the number of available observers and the distance they could cover per day. People searching on foot was not sufficiently well documented to allow a quantifiable comparison of the effectiveness of this technique with using observers on horseback, but anecdotal evidence suggests it is inefficient and not feasible in areas where bilbies are in low densities over a large area.

Southgate *et al.* (2005) reported on a trial to evaluate the efficacy of three techniques to record measures of bilby activity in the Tanami Desert. Similar to our experience, they reported that using ATVs along tracks (fixed transects) was ineffective and suggested a combination of aerial survey (helicopter) and searching random, 200 m x 300 m (6 ha) ground plots on foot. Using helicopters at Lorna Glen is cost prohibitive and searching on foot is very time consuming and physically demanding if large areas are to be searched routinely. We needed to evaluate an alternative efficient and cost-effective method to monitor signs of bilby activity (tracks, diggings, scats, burrows) as a surrogate for relative abundance and distribution.

This note reports on the efficacy of using observers on horseback surveying belt transects cross-country to record signs of bilby activity as a basis for determining bilby occurrence and relative abundance, as measured by levels of activity. As a means of transport, horses are likely to be advantageous due to their lower environmental impact than off-road vehicles, their ability to negotiate difficult terrain including thick scrub, recently burnt and long unburnt spinifex, and they provide an elevated observation platform.

METHODS

Two stock horses were transported by float to Lorna Glen for the duration of the survey (28–31 March 2011) and stabled in the disused cattle yards near the homestead. The animals were fed a weed-seed-free diet from three days prior to arriving to reduce the possibility of introducing new weeds to the property (Van Weyenberg *et al.* 2006).

A trial survey area of ~2800 ha was delineated on a map around one of the bilby release sites, with the release site being near the centre of the sample area. Aerial photographs of the trial area enabled an assessment of the dominant soil and vegetation types covered by the transects. Vegetation mainly comprised of spinifex (*Triodia basedowii* and *T. melvillei*)) over red sandy soil with patches of mulga (*Acacia anuera*) and soft grasses over red loamy soils, making tracks, diggings and burrows readily observable. Observations were more difficult in harder, stony country. Using an access track as a baseline, a series of six cross-country belt transects varying in length from 3.35 to 6.35 km were surveyed as a sample of the survey area. The transects were 1.65 km apart and oriented north–south to minimise sun glare and maximise track visibility. For safety, two experienced observers on horseback rode within visual contact of each other, usually not more than 40 m apart. The observers followed a pre-determined bearing and carried a GPS to navigate, to measure distance travelled and speed, and to log the location of signs of bilby activity. The observers recorded signs that were confidently identifiable as bilby. Based on the observer's experience and knowledge, burrows and diggings were identified by their size and shape; other clues such as associated tracks and scats assisted with identification. Very old diggings that were highly weathered and which could have been by varanids, bilbies or rabbits, were not recorded.

Signs of bilby activity were recorded as burrows, diggings or tracks. We defined burrows and diggings as being 'old' or 'fresh' (active) according to whether they were made, or showed signs of use as evidenced by soil disturbance and tracks, before or after the last rainfall event, which was 12 days prior to the start of the survey. Tracks were separately recorded if they were not associated with diggings or burrows. During the survey, the opportunity was taken to record conspicuous signs of other animals such as feral cat, wild dog/dingo and echidna, but these are not discussed here.

From horseback, clear, unimpeded observation distances either side of the transect to the soil surface (hence, signs of bilby activity) varied depending on the vegetation height and cover. Following a pilot trial we decided on conservative visual sample distances (survey width) of 15 m for burrows and diggings and 5 m for tracks, so only signs of activity that fell within these distances either side of each observer were recorded. We estimate that, on average, the riders were approximately 15 m apart (abreast), which gave a combined average visual sample swathe, or belt transect sample size, of ~45 000 m^2 and 15 000 m^2 for burrows and tracks respectively for each 1 km of transect.

RESULTS AND DISCUSSION

From horseback, we were readily able to observe diggings, tracks and burrows of bilbies (and signs of other animals). The stock horses easily negotiated the terrain, moving across country at an average speed of 4.4 km/hour. In open country, they walked at 6.8–7.4 km/hour, but slowed to 3.3–3.7 km/hour in more difficult terrain.

The total length of transect surveyed in this trial was 27 km of which ~20 km (74%) comprised spinifex sand plains and dunefields that had been burnt ~8–9 years previously. Of the remainder ~3.5 km (13%) was older, long unburnt spinifex and ~3.5 km (13%) was scattered shrubs, small trees and soft grasses associated with palaeochannels and stony plains. While the trial was conducted over a three day period, due to other constraints and activities, actual riding time to cover the total 27 km of transect was only 6.1 h. Once operational, two observers on horseback could comfortably survey 25 km per day.

Monitoring bilby activity from horseback had a number of advantages. Horses were able to negotiate all terrain encountered including sand dunes, recently burnt and long unburnt spinifex, thick scrub, mulga groves, rocky outcrops and calcrete. Observers did not need to 'steer' the horses and so could concentrate on observing. Being on horseback provided an elevated observation platform enabling a relatively wide swathe to be visually searched. The horses were capable of walking long distances whilst maintaining an acceptable speed, and, based on a visual assessment, had a relatively low physical impact on vegetation and soil compared with ATVs and other motorised transport. Footprints left by the horses were obliterated by subsequent rain.

Based on the conservative visual sample widths described above the total area sampled or searched was 121.5 ha for burrows and diggings and 40.5 ha for tracks. This equates to 4.3% and 1.4% of the total survey area for burrows and diggings, and tracks, respectively. Bilby activity recorded along the belt transects is summarised in Table 1, but burrows were of most interest in this survey. Ten fresh or active and nine old or inactive burrows were recorded. On the basis that the belt transects were representative of the broader survey area, this equates to one fresh bilby burrow per 12.15 ha, and either a fresh or an old burrow every 6.39 ha of survey area. Therefore, the estimated number of fresh bilby burrows in the 2849 ha survey area is 234.

As the primary objective of this trial was to test the efficacy of using observers on horseback to survey for

Table 1 Summary of bilby activity observed along horseback transects.

Transect	Survey time (h)	Distance (km)	Active burrows	Old burrows	Fresh diggings	Old diggings	Fresh tracks	Detection efficiency
Day 1 T1 & T2	2.9	12.7	7	2	3	0	4	5.5
Day 2 T3 & T4	1.7	7.6	0	2	0	3	0	2.9
Day 3 T5 & T6	1.5	6.7	3	5	3	5	3	12.7
Total	6.1	27	10	9	6	8	7	6.6

For the purpose of this trial, only two transects were surveyed per day over three days. Fresh activity refers to soil disturbance after a rainfall event 12 days before the survey. Detection efficiency is number of sightings of bilby activity per hour of searching.

signs of bilby (and other animal) activity, the actual survey effort (time and distance) was relatively small. Based on 27 km of survey transect, the distribution of bilby burrows along a transect was scattered or random rather than clumped, with the exception that no burrows were recorded on the harder substrates associated with palaeochannels and stoney plains. Burrows and diggings were observed in long unburnt and recently burnt spinifex, and while diggings were easier to see in recently burnt spinifex, burrows were seen equally well in both seral stages. The frequency with which signs of bilby activity were encountered (activity sightings per hour of observation) varied considerably between the transects (Table 1). This was probably due to the varying substrates, with bilby activity confined to deeper sandy or loamy soils that are easier to dig, and to the direction of dispersal of re-introduced animals. For example transects 3 & 4 had least activity (Table 1) and were the most westerly transects, suggesting few bilbies had moved in this direction since their release. Fresh signs of activity such as diggings and burrows are evidence of bilby presence, but they do not reveal the actual number of bilbies (Lavery & Kirkpatrick 1997; Moseby & O'Donnell 2003). However, burrow density is likely to be indicative of the relative abundance of bilbies, but further research is required to establish this relationship.

We recorded relatively few bilby diggings (Table 1) possibly because we recorded diggings only if we were confident that they were bilby rather than other species. Alternatively, given the good season and abundant fresh plant growth, the bilbies may not have been digging as much for food.

Measured in terms of area searched per unit of time, observers on horseback travelling cross-country proved to be a more efficient technique for searching for signs of bilby activity than observers on foot. Southgate *et al.* (2005) reported that it took 57 days for three observers on foot to search for signs of activity in 164 randomly located 6 ha plots. While it is not clear whether this included travel time, this equates to a productivity rate of ~17 ha searched per day, or ~6 ha per day per observer. Under operational conditions (rather than trial) two observers on horseback working 30 m apart could comfortably search 120 ha per day (4.5 h actual search time) for burrows (20 km long x 60 m wide belt transect), or 60 ha per day per observer. Other comparisons with trails reported by Southgate *et al.* (2005), such as detection efficiency, are not meaningful given differences in terrain and habitat, observer experience, and that we were surveying a recently re-introduced population rather than a 'wild' population.

CONCLUSIONS

Whatever the method of transport (foot, aerial, horseback) local habitat and terrain conditions and observer experience and skill are important factors determining detection efficiency and reliability. However, using observers on horseback to survey for signs of bilbies and other animals that are difficult to trap or spotlight proved to be an effective, low impact method of transport and a good observation platform in this landscape. While diggings and tracks can be recorded, we suggest recording burrows is more useful because they are more distinctive, relatively easy to see, are persistent in the landscape and may be a better indicator of bilby abundance. Using the number or density of fresh burrows as an index of bilby abundance, repeat surveys for burrows should enable the trend in the relative abundance of bilbies to be monitored. This trial was too small to undertake a statistically rigorous analysis of whether a sample size of 4.3% of the survey area is adequate. Further operational surveys including increasing the sampling effort to ~6% will build a dataset to enable analysis.

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